DARPA BIO – Harvesting Biology for Defense Technology
Participation in the Biotechnology Industry Organization Annual Conference
Washington DC, June 23-25, 2003

Schedule of Events at DARPA BIO Booth #2112

Monday, June 23rd
Enhancing Human Performance

Time	Program	Program Manager	Highlights
11:00 AM	Metabolic Engineering for Cellular Stasis, Metabolic Dominance, & Engineered Tissue Constructs	Dr. Joe Bielitzki	• Tailored immune responses based on dendritic cell and tissue engineering
11:50 AM	Persistence in Combat (PIC)	Dr. Kurt Henry	• Low level energy light arrays for the treatment of acute traumatic neurological injury
12:40 PM	Continuous Assisted Performance (CAP)	Dr. John Carney	
1:30 PM	Brain Machine Interface (BMI)	Dr. Alan Rudolph	• Retinal prosthetics • Brain Machine Interface Technology including device architecture and microelectronic devices
2:20 PM	Augmented Cognition (AugCog)	Dr. Dylan Schmorrow	• Overview of Aug Cog program and closed loop systems under development
3:10 PM	BioCOMP – Bio-computation	Dr. Sri Kumar	• BioSPICE: a computational framework, analytical techniques and bioinformatic tools capable of predicting cellular processes and controlling their spatio-temporal behavior
4:00 PM	CEROS –Center of Excellence for Research In Ocean Sciences	Dr. Theo Kooij	• Ramanprobes systems for Improved Chemical and Biosensors

Tuesday, June 24th
Protecting Living Assets

Time	Program	Program Manager	Highlights
10:00 AM	Triangulation Identification for Genetic Evaluation of Risks (TIGER)	Dr. Steve Buchsbaum	
10:50 AM	Spectral Sensing of Bio- Aerosols	Dr. Tom McCreery	
11:40 AM	Biosensor Technologies	Dr. Millie Donlon	• Handheld biosensor based on upconverting phosphor technology (UPT) • Mesosystems Inc. personal sampler
12:30 AM	Biochip Biosensors	Dr. Millie Donlon	• MAGIC Chip: Biochip Platform for detection of biological agents based on genetic signatures from genome information.

1:20 PM	Biosensor Technologies	Dr. Wayne Bryden	• A Fieldable Mass Spectrometer System for Airborne Biological Particle Detection
2:10 PM	Activity Detection Technologies (ADT)	Dr. Alan S. Rudolph	• Portable Neuronal Cell-Based Biosensor • Engineered Yeast Based Biosensor
3:00 PM	Advanced Diagnostics	Dr. Alan Rudolph	• Real Time DNA Sequencing • Portable Swab Sample Processor and Analyzer • Catalytic conformational Sensor
3:50 PM	Biological Input Output Systems (BIOS) & Fundamental Research at the [Bio:Info:Micro] Intersection	Dr. Eric Eisenstadt, Dr. Douglas Gage, Dr. Michael Krihak	• Using Organisms as Sentinels • Basic research in neurosciences and regulatory cell biology
4:40 PM	Unconventional Pathogen Countermeasures	Dr. John Carney	
5:30 PM	SUVOS – Semiconductor Ultraviolet Optical Sources	Dr. John Carrano	• Recent technology achievements in areas of UV laser diodes and UV LED's • The BioLert real-time bio-sensor

Wednesday, June 25th
Improving System Performance

Time	Program	Program Manager	Highlights
10:00 AM	Biodynotics – Biologically Inspired Multifunctional Dynamic Robots	Dr. Alan Rudolph	• RHex: A behaviorally integrated fully autonomous robot inspired by insect locomotion
10:50 AM	Controlled Biological Systems (CBS)	Dr. Alan Rudolph	• Local Insect Communities as Biohazard Sentinels
11:40 AM	Biomolecular Motors (BMM)	Dr. Alan Rudolph	•
12:30 PM	SIMBIOSYS – Simulation of Bio-Molecular Microsystems	Dr. Anantha Krishnan	• BioNems: Biofunctionalized Nanoelectromechanical Systems
1:20 PM	BioMagnetICs – Bio-Magnetic Interfacing Concepts	Dr. Valerie Browning	•
2:10 PM	SPORE – Spectroscopic Observation of Remote Environments	Dr. Doug Cochran, Dr. Carey Schwartz, Dr. Eric Eisenstadt, Dr. Stu Wolf	• FAST CARS Project – Femto second Adaptive Spectroscopic Techniques Applied to Coherent Anti-Stokes Raman Spectroscopy
3:00 PM	EXOSKELETONS	Dr. John Main	• Enhanced human performance using mechanical assist devices

Detailed Description of DARPA Program Exhibits:

Monday, June 23rd:

Enhancing Human Performance

DARPA will present current programs and demonstrate technologies aimed at sustaining or enhancing human performance. Thrust areas include neurosciences, metabolic engineering, nutrition, and genomics.

11:00 AM
Program: Metabolic Dominance
Program Manager: Dr. Joe Bielitzki
Description of Program: The Metabolic Dominance Program aims to develop novel strategies that exploit and control the mechanisms of energy production, metabolism, and utilization during short periods of deployment requiring unprecedented levels of physical demand. The ultimate goal is to enable superior physical and physiological performance of the warfighter by controlling energy metabolism on demand.
Highlights:

Program: Metabolic Engineering for Cellular Stasis
Program Manager: Dr. Joe Bielitzki
Description of Program: The primary objective of this program is to identify materials, mechanisms, and integrated processes for controlling cellular metabolism and activity in cells, tissues, organs, and model organisms and apply this knowledge to the development of useful products that would assist in providing medical care on the battlefield. A chief focus is to develop reversible methods for the long-term storage of platelets, erythrocytes, leukocytes, lymphocytes, hematopoetic stem cells, and mesenchymal stem cells.
Highlights:

Program: Engineered Tissue Constructs
Program Manager: Dr. Joe Bielitzki
Description of Program: The Engineered Tissue Constructs (ETC) Program explores the technologies and science leading to the creation of a 3-D ex vivo human immune system. This system will be used for testing new vaccine constructs and immunomodulators that provide superior protection against threat agents. The ETC Program seeks to develop reliable methodologies that will accelerate the science and technology base necessary to achieve 3-D tissue engineering and to define the spatial and temporal requirements necessary to expand its applicability.
Highlights:
Dr. William Warren of Sciperio, Inc. will be present in the booth to discuss the Dendritic Cell Node (DCN), tailored immune responses based on dendritic cell and tissue engineering

11:50 AM
Program: Persistence in Combat (PIC)
Program Manager: Dr. Kurt Henry
Description of Program: The goal of the Persistence in Combat Program is to develop technologies that allow warfighters to administer self-aid for minor to moderate battfield injuries, thereby significantly reducing the requirements for medic support and/or evacuation. Examples of technologies of interest include novel non-invasive therapeutic technologies, nervous system control of bleeding, and management of acute traumatic pain.

Highlights: Dr. CAPT Harry Whelan, of the Medical College of Wisconsin will discuss & demonstrate low level energy light arrays for the treatment of acute traumatic neurological injury

12:40 PM
Program: Continuous Assisted Performance
Program Manager: Dr. John Carney
Program Description: The goal of the Continuous Assisted Performance (CAP) Program is to identify approaches that extend the performance envelope of the warfighter. Specifically, the program will develop a number of different strategic approaches to prevent the effects of sleep deprivation over an extended period of time, nominally set at 7 days (24/7). These approaches will capitalize on emerging concepts in neuroscience, neurobiology, cognitive psychology, cell signaling/regulation, noninvasive imaging technologies, and novel mathematical approaches to modeling and analysis.
Highlights:

1:30 PM
Program: Brain Machine Interface
Program Manager: Dr. Alan S. Rudolph
Program Description: The goal of the Brain Machine Interface Program (BMI) is to create new technologies for augmenting human performance through the ability to noninvasively access codes in the brain in real time and integrate them into peripheral device or system operations.
Highlights: Dr. Dean Scribner of the Naval Research Laboratory will be present in the booth discussing and demonstrating the development of retinal prosthetic technology. In addition, Dr. Patrick Wolf of Duke University will present to discuss and showcase technology that is being developed to create the Brain Machine Interface. This will include an overview of practical device architecture and some specific microelectronic devices used to monitor and stimulate neurons.

2:20 PM
Program: Augmented Cognition (AugCog)
Program Manager: Dr. Dylan Schmorrow
Program Description: The mission of the DARPA Augmented Cognition program is to extend, by an order of magnitude or more, the information management capacity of the human-computer warfighting integral by developing and demonstrating quantifiable enhancements to human cognitive ability in diverse, stressful, operational environments. A key objective of the program is to foster development of novel- and improvement of identifiable- prototypes and enabling technologies, in order to experiment with and understand the means by which they may be integrated into existing operational systems, as well as those in development. The program will accomplish this by delivering new design principles for human-computer symbiosis.
Highlights:
Dr. Amy Kruse of Strategic Analysis, Inc. will be present to discuss an overview of the Augmented Cognition Program including details on the closed loop systems under development and the current technical challenges and technologies in use in the program.

3:10 PM
Program: BioCOMP
Program Manager: Dr. Sri Kumar
Program Description: The mission of BIO Comp is to develop a computational framework that enables the construction of sophisticated models of intracellular processes that can be used to predict and control the behavior of living cells. In addition, to generate new computational paradigms and engineering applications that utilize biomolecules as an information processing, sensing, or structural components. The BioComputation program has two principal goals. First, the program aims to develop BioSPICE: a

computational framework, analytical techniques and bioinformatic tools capable of predicting cellular processes and controlling their spatio-temporal behavior. The system will enable the rapid exploration how external agents (i.e., a novel pathogen) disrupt normal cellular function allowing for a theoretical approach to the design of pharmacologic interventions. Importantly, BioSPICE algorithms will be validated and extended via in vitro and in vivo experimentation. Secondly, the program aims to explore the role of biomolecules in computer and engineering applications. This encompasses: a) the development of scalable nucleotide manipulation techniques for realizing computational methods capable of solving highly complex, NP-complete problems; b) the design of ultra-high density information storage systems; and c) the development of programmable nucleic acid nano-structures.
Highlights:

3:10 PM
Program: CEROS – Center of Excellence for Research in Ocean Sciences
Program Manager: Dr. Theo Kooij
Program Description: The goal of the CEROS program is to conduct concept exploration, analysis, study, and development of ocean technologies and applied ocean science in the areas of Shallow Water Surveillance Technologies, Ocean Environmental Preservation, New Ocean Platform and Ship Concepts, Ocean Measurement Instrumentation and Ocean Engineering Tools, and Unique Properties of the Deep Ocean Environment.
Highlights: Dr. Christian Schoen, Concurrent Analytical, Inc. to discuss and present his work with Raman probes systems for Improved Chemical and Biosensors

Tuesday, June 24th

Protecting Living Assets

DARPA will present current programs and demonstrate technologies aimed at defending against inherent, natural, engineered, and emerging biological threats. Thrust areas include next generation biosensors and sensor systems, diagnostics, therapeutics, personnel protection, and biological processing and manufacturing

10:00 AM
Program: TIGER- Triangulation Identification for Genetic Evaluation of Risks
Program Manager: Dr. Steve Buchsbaum
Description of Program: The objectives of this program are to build a universal sensor to detect all known, newly emergent, or bio-engineered pathogens with high sensitivity and specificity and very low false alarm rate. The TIGER sensor is based on PCR with primers pairs anchored to universal sites and amplifying species-identifying variable regions. High resolution mass spectrometry followed by maximum-likelihood detection processing are used to analyze the PCR products, identify the pathogenic and background organisms present, and estimate the quantity of each organism in the sample.
Highlights:

10:50 AM
Program: Spectral Sensing of Bio-Aerosols Program
Program Manager: Dr. Steve Buchsbaum, Dr. Thomas McCreery
Description of Program: The Spectral Sensing of Bio-Aerosols program will develop sensors to address the urgent need for biological weapons agent (BWA) trigger sensors and detect-to-warn sensors with fast response times and significantly improved false alarm rates (Pfa). The goal of this program is to

develop point detection sensors with response times of less than one minute and with at least a one order of magnitude reduction in false alarm rate relative to current sensors.
Highlights:

11:40 AM
Program: Biosensor Technologies
Program Manager: Dr. Millie Donlon
Description of Program: The goal of the Biosensor Technologies Program is to identify and develop new component technologies which will enable the development of fast, highly sensitive, and highly specific biosensor systems that will reduce false alarm rates and increase the ability to detect and identify multiple biological warfare agents. The following biosensor technologies are currently under development to support this goal: upconverting phosphors, a phylogenic microchip, the enhancement/replacement of antibodies, and mass spectrometry technologies.
Highlights: SRI International has developed a handheld sensor that allows highly sensitive, rapid detection of multiple pathogens (bacteria, viruses, and toxins) simultaneously. The sensor uses the upconverting phosphor technology (UPT) reporter system to color-code multiple pathogens simultaneously in a lateral flow immunoassay test strip. Dr. Bill Wright from SRI will be in the booth to discuss and demonstrate the handheld sensor. Dr. Andrew Kamholz of MesoSystems technology will be present in the booth to discuss and demonstrate MesoSystems' Personal Sampler.
Dr. Joany Jackman from John Hopkins University Applied Physics Laboratory Dr. Joany Jackman from JHU/APL will be present in the booth to discuss the MAGIChip microarray technology. This technology is used to identify pathogenic bacteria at the species level from other related bacteria. The MAGIChip phylogenetic approach does not require PCR for basic identification but does harmonize with existing PCR-based approaches for detection of virulence factors in pathogens.
Dr. Elsie Quaite Randall, Argonne National Laboratory will also discuss and demo a biochip developed at ANL that is a microarray of minute 3D gel pads that facilitates the examination of biochemical reactions, from nucleic acid hybridization to antibody detection. The BIO demonstration shows a chip designed to detect biological agents based on genetic signatures derived from genome information.

1:20 PM
Program: Biosensor Technologies
Program Manager: Dr. Wayne Bryden
Description of Program: The goal of the Biosensor Technologies Program is to identify and develop new component technologies which will enable the development of fast, highly sensitive, and highly specific biosensor systems that will reduce false alarm rates and increase the ability to detect and identify multiple biological warfare agents. The following biosensor technologies are currently under development to support this goal: upconverting phosphors, a phylogenic microchip, the enhancement/replacement of antibodies, and mass spectrometry technologies.
Highlights: Dr. Wayne Bryden will discuss and demonstrate a fieldable mass spectrometer system for Airborne Biological Particle Detection

2:10 PM
Program: Activity Detection Technologies
Program Manager: Dr. Alan Rudolph
Description of Program: The goal of the DARPA Activity Detection Technologies Program is to develop and demonstrate detection systems capable of extracting information on the biological activity, mechanisms of action, and consequences of exposure to chemical and biological agents of interest to the Department of Defense. The development of activity detection systems revolve around capturing the sensitivity and functional sensory performance of biological cells and tissues and the creation of biological signatures from these systems for environmental detection or advanced medical diagnostics.

Highlights: Dr. Joe Pancrazio of the Naval Research Laboratories will be present to discuss and demonstrate the development of a portable system capable of extracellular recording from excitable cells such as cultured neuronal networks. In addition, Dr. Mike Brasch of Atto Biosciences will discuss and demonstrate the development of a system based on genetic integration of the olfactory signal transduction system into yeast cells.

3:00 PM
Program: Advanced Diagnostics
Program Manager: Dr. Alan Rudolph
Description of Program: The objectives of the Advanced Diagnostics Program are to provide the capability to detect in the body or in clinical samples—in real time and in the absence of recognizable signs and symptoms and when pathogen numbers are still low—the presence of infection by any pathogen. Specific areas of interest include, but are not limited to, multiagent diagnostics capable of simultaneously identifying a broad range of pathogens (infectious agents or their products) in clinical samples or in the body; strategies for identifying both known and presently unknown or bioengineered pathogens (e.g., diagnostic approaches based on fundamental, critical mechanisms of pathogenesis, targets shared by classes of pathogens, or early host responses to infection); capabilities for the continuous monitoring or immediate recognition of infection in the body; and wearable diagnostics for noninvasive broad-spectrum detection of infection in the body.
Highlights:
Dr. Susan Hardin of VisiGen Biotechnologies Inc. will be present to discuss a novel sequencing system based on engineering DNA polymerase and nucleotide triphosphates to function as direct molecular sensors of DNA base identity. In addition, Dr. Peter Andreotti of Atlantic Scientific Development Inc. will discuss and demonstrate the development of a new sample collection and processing workstation to collect and process environmental samples. Also, Dr. Cindy Orser of Areté Biodefense will be present to provide an overview of the Catalytic Conformational Sensor currently under development through DARPA funding. The sensor has immediate application for the detection of infectious prion material with future applications for Alzheimer¹s Disease
as well as other conformational diseases.

3:50 PM
Program: Biological Input Output Systems (BIOS)
Program Manager: Dr. Eric Eisenstadt
Description of Program: The Biological Input/Output Systems Program will develop robust technologies for designing DNA-encoded "plug and play" modules that will enable the use of organisms (e.g., plants, microbes, lower eukaryotes) as remote sentinels for reporting the presence of chemical or biological analytes
Highlights:
Dr. Guido Zuccarello, from Booz Allen Hamilton, will be present to provide an overview of the BIOS program including highlights of projects developing technologies for using organisms as sentinels.

3:50 PM
Program: Fundamental Research at the [Bio:Info:Micro] Interface (BIM)
Program Manager: Dr. Eric Eisenstadt, Dr. Douglas Gage, Dr. Michael Krihak
Description of Program: The Bio:Info:Micro Program is a collaborative effort involving three DARPA offices—the Defense Sciences Office, the Information Processing Technology Office, and the Microsystems Technology Office. The program brings together interdisciplinary teams of researchers from the fields of biology, information technology and microsystems technology to work collaboratively to address research issues at the intersections of these broadly defined areas.
Highlights: Dr. Guido Zuccarello, from Booz Allen Hamilton, will be present to provide an overview of the Bio:Info:Micro Program and highlights from six basic research efforts in the neurosciences and regulatory cell biology.

4:40 PM
Program: Unconventional Pathogens Countermeasures
Program Manager: Dr. John Carney
Description of Program: The focus of the Unconventional Pathogen Countermeasures Program is the development of revolutionary, broad-spectrum medical countermeasures against significantly pathogenic microorganisms and/or their pathogenic products. These countermeasures will be versatile enough to eliminate biological threats, whether from natural sources or modified through bioengineering or other manipulation. They will also have the potential to provide protection both within the body and at the most common portals of entry (e.g., inhalation, ingestion, skin contact
Highlights:

5:30 PM
Program: SUVOS –Semiconductor Ultraviolet Optical Sources
Program Manager: Dr. John Carrano
Program Description: The goal of the SUVOS program to exploit the unique characteristics of wide bandgap semiconductors to produce optical sources operating in the ultraviolet portion of the spectrum that can be integrated into modules and subsystems to address applications such as biological agent detection, non-line-of-sight (NLOS) covert communications, water purification, equipment/personnel decontamination, and white light generation
Highlights:
Dr. Mike Wraback, of the Army Research Labs, will give an overview of the DARPA MTO SUVOS program, and will demonstrate recent technology achievements in the areas of UV laser diodes and UV LED's. Also, Dr. Geoff Wilson of Pacific Scientific Instruments, will discuss and demonstrate the BioLert real-time biosensor developed under the SUVOS program.

Wednesday, June 25th

Improving System Performance

DARPA will present current programs and demonstrate technologies that use the unique design principles, materials, and processes of biology to reverse engineer technologically superior devices and systems for defense applications. Thrust areas include biomimetic materials, robots, assembly, manufacturing, signal processing, sensors, and intelligent machines.

10:00 AM
Program: Biodynotics – Biologically Inspired Multifunctional Dynamic Robots
Program Manager: Dr. Alan Rudolph
Program Description: One of the many shortcomings of todays robotic platforms is the limited mobility and behavior in operational environments. The Biodynotics program aims to capture the unique principles and practices of biological systems in robotic platforms to dramatically increase their performance in tasks for national security needs (e.g., surveillance, search and rescue, sentry duty, logistics support, chemical and biological agent detection) The program is exploring areas such as biologically inspired appendages for dynamic mobility, biological inspirations in animal behavior for autonomous navigation, and the integration of locomotion and behavior.
Exhibit Highlights: Dr. Alan Rudolph will be present in the booth to showcase the various platforms under development in this program including Rhex, an autonomous robot that blends insight form insect locomotion, dynamical systems theory, and robotics.

10:50 AM
Program: Controlled Biological Systems
Program Manager: Dr. Alan Rudolph
Program Description:
The goal of the Controlled Biological and Biomimetic Systems Program is to understand and exploit the basic strategies that an organism uses to optimize fitness. These strategies include unique locomotory, navigation, sensory fusion, and target recognition strategies that capture the innate ability of biological organisms to collect necessary information about their environment. Application areas of interest include developing new animal or animat sentinels that could report on the presence of desired information about the environment such as the presence of toxins or human survivors in search and rescue missions.
Exhibit Highlights:
Dr. Karen Kester of Virginia Commonwealth University will be present to discuss and demonstrate the use of insect sentinels for monitoring bioterrorism and other hazardous agents in the environment. A model insect community comprised of common and easily identifiable key insect carrier species ("KICS") has been constructed for sampling different habitats, microhabitats and time periods, and forms the basis of a relational database with GPS component used for predicting the location of target agents. Insect sentinels can be assayed for the presence of target agents using a variety of detection technologies including PCR, immunoassay, microarray and MALDI TOF.

11:40 AM
Program: Biomolecular Motors (BMM)
Program Manager: Dr. Alan Rudolph & Dr. Anantha Krishnan
Program Description:
Biomolecular motors are nature's nanomachines that convert chemical energy into mechanical work with performance and scale unparalleled by any manmade motors or machines. The principle goal of this program is to develop an understanding of the fundamental operating principles of biomolecular motors and exploit this knowledge to harvest, modify, and integrate these macromolecular assemblies into useful devices from the nano to macro scale.
Highlights:

12:30 PM
Program: SIMBIOSYS –Simulation of Bio-Molecular Microsystems
Program Manager: Dr. Anantha Krishnan
Program Description: Integrated biological/chemical microsystems offer the potential to significantly improve the speed, sensitivity, specificity, efficiency and affordability of chemical/biological processing and analysis. DARPA's vision of using integrated microsystems for the sensing and detection of chemical/biological agents requires that these sensors be designed with a good understanding of the interface between the biology and the engineering in these systems.The SIMBIOSYS program focuses on the development of advanced computational design tools that enable the efficient integration of bio-molecular phenomena with electronic, MEMS and photonic technologies. Specifically, SIMBIOSYS targets the development of data, models and algorithms for the analysis of (i) molecular recognition processes, (ii) transduction of molecular recognition signals into measurable optical, electrical and mechanical signals, and (iii) on-chip fluidic/molecular transport phenomena.
Highlights: Dr. Michael Roukes, California Institute of Technology to discuss and present his work done under the SIMBIOSYS program, BioNems: Biofunctionalized Nanoelectromechanical Systems

1:20 PM
Program: BioMagnetICs – Bio-Magnetic Interfacing Concepts
Program Manager: Dr. Valerie Browning
Program Description:

The Bio-Magnetic Interfacing Concepts (BioMagnetICs) Program explores and demonstrates the utility of nanoscale magnetics as a portable, robust, and highly sensitive transduction mechanism for monitoring and controlling biological activity at the cellular and, ultimately, single molecule level.
Highlights:

2:10 PM
Program: SPORE – Spectroscopic Observation of Remote Environments
Program Manager: Dr. Doug Cochran, Dr. Carey Schwartz, Dr. Eric Eisenstadt, Dr. Stu Wolf
Program Description: The objective of the SPORE program is to develop spectroscopic techniques for stand - off detection of biological and chemical agents in the atmosphere. The approach includes using signal enhancing spectroscopic techniques like FAST CARS (Femtosecond Adaptive Spectroscopic Techniques Applied to Coherent Anti-Stokes Raman Spectroscopy) and acousto-optics to detect at kilometer ranges with high selectivity and sensitivity.
Highlights:

3:00 PM
Program: Exoskeletons for Human Performance Augmentation
Program Manager: Dr. John Main
Program Description:
The overall goal of the Exoskeletons for Human Performance Augmentation (EHPA) Program is to develop devices and machines that will increase the speed, strength, and endurance of soldiers in combat environments. Projects will lead to self-powered, controlled, and wearable exoskeletal devices and/or machines and demonstrations of their utility in military applications.
Highlights:
Enhanced human performance using mechanical assist devices.